263d Identification and Characterization of Semivolatile Organic Carbon Using Proton Transfer Reaction - Mass Spectrometry (Ptr-MS)

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We present an analysis of volatile and semivolatile species produced during monoterpene oxidation using proton transfer reaction - mass spectrometry (PTR-MS). Partitioning theory dictates that atmospheric organic species with finite saturation vapor pressures must exist in both the gas and aerosol phases. Such species are typically defined as semivolatile, and a number of semivolatile species, particularly monoterpene oxidation products, have been identified using filter-based methods. However, the relative abundances of these semivolatile products in the gas and aerosol phases has not been investigated previously. The high time resolution of the PTR-MS allows us to investigate changes in organic concentrations on the order of a few minutes; this time resolution starkly contrasts filter-based measurements, which may take hours to collect.

Secondary organic aerosol (SOA) is generated in an environmental chamber by the ozonolysis of a monoterpene precursor (typically alpha-pinene or limonene) in the presence of an OH radical scavenger. The particle mass and number distributions are measured with an SMPS, and organic concentrations are monitored using PTR-MS. Species identified with PTR-MS are consistent with results from filter-based measurements, and include limononaldehyde, 7-hydroxy-limononaldehyde, and 7-hydroxy-keto-limononaldehyde from limonene ozonolysis, and pinonaldeyhde, norpinonaldehyde, norpinonic acid, and pinonic acid from alpha-pinene ozonolysis.

Additionally, PTR-MS allows us to investigate the differences between dark chamber experiments conducted in the absence of NOx with experiments conducted in high-NOx environments or in the presence of UV light. We have previously observed that the gas-phase conditions (i.e., NOx concentration) can significantly affect SOA yield. Filter-based measurements allow little insight into the underlying gas-phase chemistry that controls SOA yield. The higher time resolution (and low detection limit) of the PTR-MS allows for the investigation of changes in organic speciation both during and after terpene consumption.